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12. INTAKE OF GRAIN PRODUCTS

Consumption of grain products is a potential pathway of exposure to toxic chemicals. These food sources can become contaminated by absorption or deposition of ambient air pollutants onto the plants, contact with chemicals dissolved in rainfall or irrigation waters, or absorption of chemicals through plant roots from soil and ground water. The addition of pesticides, soil additives, and fertilizers may also result in contamination of grain products.

The U.S. Department of Agriculture's (USDA) Nationwide Food Consumption Survey (NFCS) and Continuing Survey of Food Intakes by Individuals (CSFII) are the primary sources of information on intake rates of grain products in the United States. Data from the NFCS have been used in various studies to generate consumer-only and per capita intake rates for both individual grain products and total grains. CSFII 1989-91 survey data have been analyzed by EPA to generate per capita intake rates for various food items and food groups. As described in Volume II, Chapter 9 - Intake of Fruits and Vegetables, consumer-only intake is defined as the quantity of grain products consumed by individuals who ate these food items during the survey period. Per capita intake rates are generated by averaging consumer-only intakes over the entire population of users and non-users. In general, per capita intake rates are appropriate for use in exposure assessments for which average dose estimates for the general population are of interest because they represent both individuals who ate the foods during the survey period and individuals who may eat the food items at some time, but did not consume them during the survey period.

This Chapter provides intake data for individual grain products and total grains. Recommendations are based on average and upper-percentile intake among the general population of the U.S. Available data have been classified as being either a key or a relevant study based on the considerations discussed in Volume I, Section 1.3.1 of the Introduction. Recommendations are based on data from the 1989-91 CSFII survey, which was considered the only key intake study for grain products. Other relevant studies are also presented to provide the reader with added perspective on this topic. It should be noted that most of the key and relevant studies presented in this Chapter are based on data from USDA's NFCS and CSFII. The USDA NFCS and CSFII are described below.

12.1. INTAKE STUDIES

12.1.1. U.S. Department of Agriculture Nationwide Food Consumption Survey and Continuing Survey of Food Intake by Individuals

The NFCS and CSFII are the basis of much of the data on grain intake presented in this section. Data from the 1977-78 NFCS are presented because the data have been published by USDA in various reports and reanalyzed by various EPA offices according to the food items/groups commonly used to assess exposure. Published one-day data from the 1987-88 NFCS and 1994 and 1994 CSFII are also presented. Recently, EPA conducted an analysis of USDA's 1989-91 CSFII. These data were the most recent food survey data available to the public at the time that EPA analyzed the data for this Handbook. The results of EPA's analyses are presented here. Detailed descriptions of the NFCS and CSFII data are presented in Volume II, Chapter 9 - Intake of Fruits and Vegetables.

Individual average daily intake rates calculated from NFCS and CSFII data are based on averages of reported individual intakes over one day or three consecutive days. Such short term data are suitable for estimating average daily intake rates representative of both short-term and long-term consumption. However, the distribution of average daily intake rates generated using short term data (e.g., 3-day) do not necessarily reflect the long-term distribution of average daily intake rates. The distributions generated from short term and long term data will differ to the extent that each individual's intake varies from day to day; the distributions will be similar to the extent that individuals' intakes are constant from day to day.

Day-to-day variation in intake among individuals will be great for food item/groups that are highly seasonal and for items/groups that are eaten year around, but that are not typically eaten every day. For these foods, the intake distribution generated from short term data will not be a good reflection of the long term distribution. On the other hand, for broad categories of foods (e.g., total grains) which are eaten on a daily basis throughout the year with minimal seasonality, the short term distribution may be a reasonable approximation of the true long term distribution, although it will show somewhat more variability. In this Chapter, distributions are shown for the various grain categories. Because of the increased variability of the short-term distribution, the short-term upper percentiles shown will overestimate somewhat the corresponding percentiles of the long-term distribution.

12.1.2. Key Grain Products Intake Studies Based on the CSFII

U.S. EPA Analysis of 1989-91 USDA CSFII Data - EPA conducted an analysis of USDA's 1989-91 CSFII data set. The general methodology used in analyzing the data is presented in Volume II, Chapter 9 - Intake of Fruits and Vegetables of this Handbook. Intake rates were generated for the following grain products: total grains, breads, sweets, snacks, breakfast foods, pasta, cooked cereals, rice, ready-to-eat cereals, and baby cereals. Appendix 12A provides the food codes and descriptions used in this grain analysis. The data for total grains have been corrected to account for mixtures as described in Volume II, Chapter 9 - Intake of Fruits and Vegetables and Appendix 9A using an assumed grain content of 31 percent for grain mixtures and 13 percent for meat mixtures. Per capita intake rates for total grains are presented in Tables 12-1. Table 12-2 through 12-10 present per capita intake data for individual grain products. The results are presented in units of g/kg-day. Thus, use of these data in calculating potential dose does not require the body weight factor to be included in the denominator of the average daily dose (ADD) equation. It should be noted that converting these intake rates into units of g/day by multiplying by a single average body weight is inappropriate, because individual intake rates were indexed to the reported body weights of the survey respondents. However, if there is a need to compare the intake data presented here to intake data in units of g/day, a body weight less than 70 kg (i.e., approximately 60 kg; calculated based on the number of respondents in each age category and the average body weights for these age groups, as presented in Volume I, Chapter 7) should be used because the total survey population included children as well as adults.

The advantages of using the 1989-91 CSFII data set are that the data are expected to be representative of the U.S. population and that it includes data on a wide variety of food types. The data set was the most recent of a series of publicly available USDA data sets (i.e., NFCS 1977-78; NFCS 1987-88; CSFII 1989-91) at the time the analysis was conducted for this Handbook, and should reflect recent eating patterns in the United States. The data set includes three years of intake data combined. However, the 1989-91 CSFII data are based on a three day survey period. Short-term dietary data may not accurately reflect long-term eating patterns. This is particularly true for the tails of the distribution of food intake. In addition, the adjustment for including mixtures adds uncertainty to the intake rate distributions. The calculation for including mixtures assumes that intake of any mixture includes grains in the proportions specified in Appendix Table 9A-1. This assumption yields valid estimates of per capita consumption, but results in overestimates of the proportion of the population consuming total grains; thus, the quantities reported in Table 12-1 should be interpreted as upper bounds on the proportion of the population consuming grain products.

The data presented in this handbook for the USDA 1989-91 CSFII is not the most up-to-date information on food intake. USDA has recently made available the data from its 1994 and 1995 CSFII. Over 5,500 people nationwide participated in both of these surveys providing recalled food intake informatin for 2 separate days. Although the 2-day data analysis has not been conducted, USDA published the results for the respondents' intakes on the first day surveyed (USDA, 1996a; 1996b). USDA 1996 survey data will be made available later in 1997. As soon as 1996 data are available, EPA will take steps to get the 3-year data (1994, 1995, and 1996) analyzed and the food ingestion factors updated. Meanwhile, Table 12-11 presents a comparison of the mean daily intakes per individual in a day for grains from the USDA survey data from years 1977-78, 1987-88, 1989-91, 1994, and 1995. This table shows that food consumption patterns have changed for grains and grain mixtures when comparing 1977 and 1995 data. When comparing data from 1977 and 1995, consumption of grains mixtures and grain increased by 106 percent and 41 percent, respectively. However, consumption of grains has remained fairly constant when comparing values from 1989-91 with the most recent data from 1994 and 1995. Grain mixtures and grains increase 20 percent and 11 percent, respectively from 1989 to 1995. The 1989-91 CSFII data are probably adequate for assessing ingestion exposure for current populations, but these data should be used with caution.

12.1.3. Relevant Grain Products Intake Studies

The U.S. EPA's Dietary Risk Evaluation System (DRES) - USEPA, Office of Pesticide Programs (OPP) - EPA OPP's DRES contains per capita intake rate data for various grain products for 22 subgroups (age, regional, and seasonal) of the population. As described in Volume II, Chapter 9 - Intake of Fruits and Vegetables, intake data in DRES were generated by determining the composition of 1977/78 NFCS food items and disaggregating complex food dishes into their component raw agricultural commodities (RACs) (White et al., 1983). The DRES per capita, as consumed intake rates for all age/sex/demographic groups

combined are presented in Table 12-12. These data are based on both consumers and non-consumers of these food items. Data for specific subgroups of the population are not presented in this section, but are available through OPP via direct request. The data in Table 12-12 may be useful for estimating the risks of exposure associated with the consumption of the various grain products presented. It should be noted that these data are indexed to the reported body weights of the survey respondents and are expressed in units of grams of food consumed per kg body weight per day. Consequently, use of these data in calculating potential dose does not require the body weight factor in the denominator of the average daily dose (ADD) equation. It should also be noted that conversion of these intake rates into units of g/day by multiplying by a single average body weight is not appropriate because the DRES data base did not rely on a single body weight for all individuals. Instead, DRES used the body weights reported by each individual surveyed to estimate consumption in units of g/kg-day.

The advantages of using these data are that complex food dishes have been disaggregated to provide intake rates for a variety of grains. These data are also based on the individual body weights of the respondents. Therefore, the use of these data in calculating exposure to toxic chemicals may provide more representative estimates of potential dose per unit body weight. However, because the data are based on NFCS short-term dietary recall, the same limitations discussed previously for other NFCS data sets also apply here. In addition, consumption patterns may have changed since the data were collected in 1977-78. OPP is in the process of translating consumption information from the USDA CSFII 1989-91 survey to be used in DRES.

Food and Nutrient Intakes of Individuals in One Day in the U.S., USDA (1980, 1992; 1996a; 1996b) - USDA calculated mean per capita intake rates for total and individual grain products using NFCS data from 1977-78 and 1987-88 (USDA 1980; 1992) and CSFII data from 1994 and 1995 (USDA, 1996a; 1996b). The mean per capita intake rates for grain products are presented in Tables 12-13 and 12-14 for the two NFCS survey years, respectively. Table 12-15 presents similar data from the 1994 and 1995 CSFII for grain products.

The advantages of using these data are that they provide mean intake estimates for various grain products. The consumption estimates are based on short-term (i.e., 1-day) dietary data which may not reflect long-term consumption.

U.S. EPA - Office of Radiation Programs - The U.S. EPA Office of Radiation Programs (ORP) has also used the USDA 1977-78 NFCS to estimate daily food intake. ORP uses food consumption data to assess human intake of radionuclides in foods (U.S. EPA, 1984a; 1984b). The 1977-78 NFCS data have been reorganized by ORP, and food items have been classified according to the characteristics of radionuclide transport. The mean dietary per capita intake of grain products, grouped by age, for the U.S. population are presented in Table 12-16. The mean daily intake rates of grain products for the U.S. population grouped by regions are presented in Table 12-17. Because this study was based on the USDA NFCS, the limitations and advantages associated with the USDA-NFCS data also apply to this data set. Also, consumption patterns may have changed since the data were collected in 1977-78.

U.S. EPA - Office of Science and Technology - The U.S. EPA Office of Science and Technology (OST) within the Office of Water (formerly the Office of Water Regulations and Standards) used data from the FDA revision of the Total Diet Study Food Lists and Diets (Pennington, 1983) to calculate food intake rates. OST uses these consumption data in its risk assessment model for land application of municipal sludge. The FDA data used are based on the combined results of the USDA 1977-78 NFCS and the second National Health and Nutrition Examination Survey (NHANES II), 1976-80 (U.S. EPA, 1989). Because food items are listed as prepared complex foods in the FDA Total Diet Study, each item was broken down into its component parts so that the amount of raw commodities consumed could be determined. Table 12-18 presents intake rates for grain products for various age groups. Estimated lifetime ingestion rates derived by U.S. EPA (1989) are also presented in Table 12-18. Note that these are per capita intake rates tabulated as grams dry weight/day. Therefore, these rates differ from those in the previous tables because USDA (1980; 1992) and U.S. EPA (1984a, 1984b) report intake rates on an as consumed basis.

The EPA-OST analysis provides intake rates for additional food categories and estimates of lifetime average daily intake on a per capita basis. In contrast to the other analyses of USDA NFCS data, this study reports the data in terms of dry weight intake rates. Thus, conversion is not required when contaminants are provided on a dry weight basis. These data, however, may not reflect current consumption patterns because they are based on 1977-78 data.

USDA (1993) - Food Consumption, Prices, and Expenditures, 1970-92 - The USDA's Economic Research Service (ERS) calculates the amount of food available for

human consumption in the United States annually. Supply and utilization balance sheets are generated. These are based on the flow of food items from production to end uses. Total available supply is estimated as the sum of production (i.e., some products are measured at the farm level or during processing), starting inventories, and imports (USDA, 1993). The availability of food for human use commonly termed as "food disappearance" is determined by subtracting exported foods, products used in industries, farm inputs (seed and feed) and end-of-the year inventories from the total available supply (USDA, 1993). USDA (1993) calculates the per capita food consumption by dividing the total food disappearance by the total U.S. population.

USDA (1993) estimated per capita consumption data for grain products from 1970-1992 (1992 data are preliminary). In this section, the 1991 values, which are the most recent final data, are presented. Table 12-19 presents per capita consumption in 1991 for grains.

One of the limitations of this study is that disappearance data do not account for losses from the food supply from waste, spoilage, or foods fed to pets. Thus, intake rates based on these data may overestimate daily consumption because they are based on the total quantity of marketable commodity utilized. Therefore, these data may be useful for estimating bounding exposure estimates. It should also be noted that per capita estimates based on food disappearance are not a direct measure of actual consumption or quantity ingested, instead the data are used as indicators of changes in usage over time (USDA, 1993). An advantage of this study is that it provides per capita consumption rates for grains which are representative of long-term intake because disappearance data are generated annually. Daily per capita intake rates are generated by dividing annual consumption by 365 days/year.

12.1.4. Key Grain Products Serving Size Study Based on the USDA NFCS

Pao et al. (1982) - Foods Commonly Eaten by Individuals - Using data gathered in the 1977-78 USDA NFCS, Pao et al. (1982) calculated percentiles for the quantities of grain products consumed per eating occasion by members of the U.S. population. The data were collected during NFCS home interviews of 37,874 respondents, who were asked to recall food intake for the day preceding the interview, and record food intake the day of the interview and the day after the interview. Quantities consumed per eating occasion, are presented in Table 12-20.

The advantages of using these data are that they were derived from the USDA NFCS and are representative of the U.S. population. This data set provides distributions of serving sizes for a number of commonly eaten grain products, but the list of foods is limited and does not account for grain products included in complex food dishes. Also, these data are based on short-term dietary recall and may not accurately reflect long-term consumption patterns. Although these data are based on the 1977-78 NFCS, serving size data have been collected, but not published, for the more recent USDA surveys.

12.2. CONVERSION BETWEEN AS CONSUMED AND DRY WEIGHT INTAKE RATES

As noted previously, intake rates may be reported in terms of units as consumed or units of dry weight. It is essential that exposure assessors be aware of this difference so that they may ensure consistency between the units used for intake rates and those used for concentration data (i.e., if the unit of food consumption is grams dry weight/day, then the unit for the amount of pollutant in the food should be grams dry weight). If necessary, as consumed intake rates may be converted to dry weight intake rates using the moisture content percentages of grain products presented in Table 12-21 and the following equation:

$$IR_{dw} = IR_{ac} * [(100-W)/100] \quad \text{(Eqn. 12-1)}$$

Dry weight" intake rates may be converted to "as consumed" rates by using:

$$IR_{ac} = IR_{dw}/[(100-W)/100] \quad \text{(Eqn. 12-2)}$$

where:

IR_{dw} = dry weight intake rate;
IR_{ac} = as consumed intake rate; and
W = percent water content.

12.3. RECOMMENDATIONS

The 1989-91 CSFII data described in this section were used in selecting recommended grain, product intake rates for the general population and various subgroups of the United States population. The general design of both key and relevant studies are summarized in Table 12-22 The recommended values for intake of grain products are

summarized in Table 12-23 and the confidence ratings for the recommended values for grain intake rates are presented in Table 12-24. Per capita intake rates for specific grain items, on a g/kg-day basis, may be obtained from Tables 12-2 through 12-10. Percentiles of the intake rate distribution in the general population for total grains, are presented in Table 12-1. From these tables, the mean and 95th percentile intake rates for grains are 4.1 g/kg-day and 10.8 g/kg-day, respectively. It is important to note that the data presented in Tables 12-1 through 12-10 are based on data collected over a 3-day period and may not necessarily reflect the long-term distribution of average daily intake rates. However, for the broad categories of foods (i.e., total grains, breads), because they may be eaten on a daily basis throughout the year with minimal seasonality, the short-term distribution may be a reasonable approximation of the long-term distribution, although it will display somewhat increased variability. This implies that the upper percentiles shown will tend to overestimate the corresponding percentiles of the true long-term distribution. It should be noted that because these recommendations are based on 1989-91 CSFII data, they may not reflect the most recent changes in consumption patterns. However, as indicated in Table 12-11, intake has remained fairly constant between 1989-19 and 1995. Thus, the 1989-91 CSFII data are believed to be appropriate for assessing ingestion exposure for current populations.

12.4. REFERENCES FOR CHAPTER 12

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Table 12-1. Per Capita Intake of Total Grains Including Mixtures (g/kg-day as consumed)[a]

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	97.5%	4.061	0.033	0	0.74	1.16	1.90	3.06	4.96	8.04	10.77	18.53	42.98
Age (years)													
< 01	80.4%	7.049	0.361	0	0	0	1.46	6.05	10.18	16.75	19.50	27.61	37.41
1-2	95.8%	10.567	0.285	0	2.86	4.34	6.55	9.59	14.06	18.92	21.57	28.22	42.98
3-5	97.5%	9.492	0.201	0	3.13	4.35	6.09	8.91	11.88	15.13	19.14	23.87	33.08
6-11	97.7%	6.422	0.117	0	2.14	2.88	4.07	5.70	7.82	10.26	12.85	21.40	31.93
12-19	98.2%	3.764	0.065	0	1.15	1.52	2.16	3.31	4.81	6.46	8.03	10.92	19.30
20-39	98.4%	3.095	0.035	0	0.70	1.08	1.75	2.73	4.00	5.47	6.55	9.57	25.71
40-69	98.3%	2.792	0.031	0	0.69	0.98	1.59	2.47	3.54	4.96	6.09	8.40	20.34
70 +	98.7%	3.263	0.066	0.38	0.89	1.24	1.86	2.72	4.04	5.81	7.63	10.47	21.45
Season													
Fall	97.9%	4.282	0.066	0	0.84	1.24	2.07	3.19	5.19	8.54	11.88	19.10	37.77
Spring	97.0%	3.983	0.071	0	0.70	1.10	1.79	2.95	4.73	7.78	10.52	23.87	31.93
Summer	97.5%	3.948	0.062	0	0.74	1.13	1.82	2.99	4.96	7.98	10.16	15.34	30.13
Winter	97.6%	4.031	0.063	0	0.70	1.17	1.95	3.17	4.99	8.00	10.48	16.86	42.98
Urbanization													
Central City	97.6%	4.159	0.061	0	0.75	1.13	1.91	3.06	5.07	8.71	11.61	17.69	37.77
Nonmetropolitan	96.9%	4.013	0.067	0	0.60	1.11	1.85	3.12	4.93	7.81	10.08	21.05	31.93
Suburban	97.8%	4.02	0.049	0	0.80	1.18	1.90	3.04	4.91	7.79	10.63	18.53	42.98
Race													
Asian	94.0%	6.479	0.402	0	0	1.46	3.02	5.44	9.07	14.13	14.63	20.65	23.78
Black	96.9%	4.372	0.103	0	0.55	0.94	1.81	3.05	5.69	9.47	12.47	18.96	40.07
Native American	87.7%	3.98	0.276	0	0	0.61	1.63	3.67	5.81	6.90	9.00	20.43	21.84
Other/NA	97.1%	4.561	0.208	0	0	1.21	2.26	3.56	5.36	8.87	11.72	22.07	30.51
White	97.9%	3.962	0.035	0	0.79	1.18	1.90	3.03	4.80	7.79	10.20	18.07	42.98
Region													
Midwest	97.3%	4.016	0.07	0	0.79	1.17	1.90	2.92	4.69	7.80	11.04	20.36	31.93
Northeast	97.6%	4.255	0.079	0	0.78	1.26	2.02	3.19	5.37	8.44	11.61	17.73	42.98
South	97.9%	3.943	0.052	0	0.71	1.10	1.83	3.06	4.89	8.13	10.20	16.42	40.07
West	97.2%	4.116	0.072	0	0.69	1.13	1.92	3.13	5.03	7.98	10.90	19.50	25.89

[a] Includes breads; sweets such as cakes, pie, and pastries; snack and breakfast foods made with grains; pasta; cooked ready-to-eat, and baby cereals, rice and grain mixtures.

Note: SE = Standard error
P = Percentile of the distribution

Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-2. Per Capita Intake of Breads (g/kg-day as consumed)[a]

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	91.6%	1.133	0.010	0	0	0.19	0.48	0.90	1.50	2.31	3.04	4.67	12.99
Age (years)													
< 01	50.9%	1.072	0.102	0	0	0	0	0.34	1.65	3.29	4.06	6.09	12.99
1-2	88.9%	2.611	0.089	0	0	0.44	1.17	2.39	3.86	4.68	5.42	8.23	10.29
3-5	91.9%	2.217	0.063	0	0	0.44	1.19	2.03	3.04	4.01	5.14	6.95	12.35
6-11	93.4%	1.668	0.037	0	0	0.40	0.88	1.44	2.18	3.16	3.98	5.95	9.17
12-19	91.8%	1.068	0.025	0	0	0.21	0.45	0.91	1.46	2.15	2.78	3.43	7.44
20-39	92.9%	0.936	0.012	0	0	0.18	0.43	0.81	1.27	1.81	2.27	3.41	7.04
40-69	93.7%	0.915	0.011	0	0	0.20	0.46	0.81	1.25	1.77	2.08	2.83	11.16
70 +	95.1%	0.976	0.021	0	0.15	0.29	0.56	0.87	1.31	1.76	2.15	2.76	11.81
Season													
Fall	91.3%	1.181	0.020	0	0	0.17	0.50	0.94	1.57	2.45	3.16	5.27	11.81
Spring	91.4%	1.095	0.018	0	0	0.18	0.48	0.89	1.45	2.18	2.91	4.54	12.35
Summer	92.4%	1.126	0.018	0	0	0.21	0.48	0.90	1.51	2.24	2.98	4.43	9.17
Winter	91.2%	1.129	0.019	0	0	0.19	0.47	0.89	1.50	2.37	3.07	4.66	12.99
Urbanization													
Central City	91.2%	1.127	0.017	0	0	0.18	0.49	0.91	1.50	2.33	2.98	4.50	11.81
Nonmetropolitan	91.7%	1.184	0.020	0	0	0.18	0.48	0.93	1.54	2.51	3.24	4.97	12.99
Suburban	91.8%	1.113	0.014	0	0	0.19	0.49	0.89	1.49	2.20	2.89	4.68	12.35
Race													
Asian	78.5%	0.981	0.078	0	0	0	0.34	0.86	1.51	2.57	2.61	3.34	3.34
Black	88.8%	1.159	0.030	0	0	0.11	0.37	0.84	1.55	2.59	3.29	5.58	8.94
Native American	81.3%	1.336	0.133	0	0	0.13	0.41	0.72	1.80	2.91	4.13	9.09	11.71
Other/NA	89.1%	1.333	0.067	0	0	0	0.62	1.11	1.70	2.66	3.79	6.16	9.98
White	92.5%	1.121	0.010	0	0	0.20	0.51	0.91	1.48	2.23	2.95	4.51	12.99
Region													
Midwest	91.2%	1.109	0.018	0	0	0.20	0.50	0.90	1.49	2.22	2.91	4.43	7.97
Northeast	91.1%	1.104	0.021	0	0	0.18	0.51	0.90	1.48	2.26	2.83	4.50	9.98
South	91.8%	1.155	0.017	0	0	0.18	0.46	0.92	1.54	2.41	3.13	4.89	12.99
West	92.1%	1.153	0.022	0	0	0.19	0.49	0.91	1.48	2.35	3.12	5.14	12.35

[a] Includes breads, rolls, muffins, bagels, biscuits, cornbread, and tortillas.

Note: SE = Standard error
P = Percentile of the distribution

Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-3. Per Capita Intake of Sweets (g/kg-day as consumed)[a]

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	50.2%	0.508	0.011	0	0	0	0	0.13	0.71	1.50	2.12	3.96	13.39
Age (years)													
< 01	28.1%	0.447	0.096	0	0	0	0	0	0.41	1.42	2.26	5.51	9.35
1-2	49.6%	1.144	0.111	0	0	0	0	0.43	1.75	3.32	4.87	6.51	13.39
3-5	59.2%	1.139	0.079	0	0	0	0	0.56	1.82	3.01	4.33	6.78	9.25
6-11	63.7%	0.881	0.046	0	0	0	0	0.43	1.29	2.33	3.28	5.39	12.97
12-19	54.0%	0.511	0.030	0	0	0	0	0.22	0.75	1.47	1.99	3.25	9.65
20-39	45.0%	0.383	0.015	0	0	0	0	0	0.59	1.24	1.66	2.48	7.45
40-69	49.1%	0.381	0.015	0	0	0	0	0.08	0.55	1.13	1.58	2.70	5.70
70 +	56.3%	0.444	0.029	0	0	0	0	0.16	0.63	1.29	1.64	2.73	6.94
Season													
Fall	52.9%	0.533	0.022	0	0	0	0	0.14	0.76	1.55	2.21	3.82	13.39
Spring	48.3%	0.466	0.021	0	0	0	0	0.10	0.65	1.36	1.82	3.58	9.35
Summer	48.5%	0.527	0.025	0	0	0	0	0.06	0.70		2.35	4.54	8.73
Winter	51.2%	0.508	0.022	0	0	0	0	0.19	0.71	1.50	2.00	4.00	10.84
Urbanization													
Central City	45.3%	0.495	0.021	0	0	0	0	0.11	0.65	1.55	2.12	4.24	9.94
Nonmetropolitan	52.3%	0.593	0.025	0	0	0	0	0.25	0.82	1.58	2.34	4.52	13.39
Suburban	52.4%	0.477	0.015	0	0	0	0	0.10	0.69	1.42	2.00	3.55	9.65
Race													
Asian	37.6%	0.515	0.101	0	0	0	0	0.05	0.78	1.82	2.22	2.52	4.06
Black	39.3%	0.387	0.030	0	0	0	0	0	0.46	1.20	1.71	3.51	9.67
Native American	33.9%	0.325	0.075	0	0	0	0	0	0.33	1.47	1.48	2.44	3.78
Other/NA	32.3%	0.283	0.088	0	0	0	0	0	0.21	0.64	1.45	3.04	9.94
White	53.2%	0.537	0.012	0	0	0	0	0.17	0.77	1.55	2.17	4.09	13.39
Region													
Midwest	53.0%	0.573	0.024	0	0	0	0	0.17	0.79	1.65	2.41	4.00	12.97
Northeast	55.9%	0.587	0.027	0	0	0	0	0.22	0.83	1.63	2.21	4.60	13.39
South	47.5%	0.471	0.018	0	0	0	0	0.09	0.65	1.39	1.98	3.89	10.84
West	46.7%	0.416	0.022	0	0	0	0	0	0.55	1.25	1.91	3.33	9.65

[a] Includes cakes, cookies, pies, pastries, doughnuts, breakfast bars, and coffee cakes.

NOTE: SE = Standard error
P = Percentile of the distribution

Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-4. Per Capita Intake of Snacks Containing Grain (g/kg-day as consumed)[a]

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	40.3%	0.160	0.005	0	0	0	0	0	0.18	0.47	0.78	1.74	6.73
Age (years)													
< 01	31.4%	0.321	0.064	0	0	0	0	0	0.35	1.24	1.82	4.66	5.73
1-2	46.7%	0.398	0.040	0	0	0	0	0.10	0.65	1.30	1.61	2.03	6.73
3-5	48.9%	0.393	0.034	0	0	0	0	0.12	0.58	1.22	1.65	2.20	4.76
6-11	43.1%	0.269	0.023	0	0	0	0	0	0.32	0.86	1.24	2.43	4.00
12-19	40.2%	0.170	0.016	0	0	0	0	0	0.21	0.50	0.74	1.94	3.51
20-39	38.2%	0.123	0.007	0	0	0	0	0	0.15	0.41	0.60	1.21	4.60
40-69	40.3%	0.104	0.006	0	0	0	0	0	0.14	0.33	0.46	1.06	2.85
70 +	40.9%	0.074	0.007	0	0	0	0	0	0.10	0.20	0.36	0.70	1.47
Season													
Fall	41.6%	0.180	0.012	0	0	0	0	0	0.18	0.50	0.87	1.99	6.73
Spring	38.3%	0.136	0.009	0	0	0	0	0	0.15	0.43	0.67	1.29	3.43
Summer	37.5%	0.165	0.010	0	0	0	0	0	0.18	0.52	0.86	1.72	5.73
Winter	43.9%	0.160	0.010	0	0	0	0	0	0.19	0.44	0.76	1.77	4.60
Urbanization													
Central City	36.5%	0.158	0.010	0	0	0	0	0	0.16	0.46	0.81	1.81	3.70
Nonmetropolitan	39.8%	0.144	0.009	0	0	0	0	0	0.17	0.44	0.66	1.32	4.76
Suburban	43.3%	0.169	0.008	0	0	0	0	0	0.18	0.50	0.80	1.75	6.73
Race													
Asian	22.1%	0.077	0.035	0	0	0	0	0	0.04	0.27	0.37	1.09	1.34
Black	25.9%	0.107	0.014	0	0	0	0	0	0.07	0.33	0.59	1.19	4.76
Native American	30.4%	0.142	0.050	0	0	0	0	0	0.16	0.32	0.44	1.29	4.60
Other/NA	28.3%	0.139	0.026	0	0	0	0	0	0.17	0.43	0.69	1.27	1.91
White	43.7%	0.170	0.006	0	0	0	0	0	0.19	0.49	0.81	1.80	6.73
Region													
Midwest	45.2%	0.202	0.012	0	0	0	0	0	0.23	0.57	0.99	1.95	6.73
Northeast	35.8%	0.113	0.010	0	0	0	0	0	0.10	0.35	0.61	1.28	5.73
South	39.8%	0.162	0.008	0	0	0	0	0	0.19	0.46	0.80	1.63	4.76
West	39.4%	0.155	0.011	0	0	0	0	0	0.16	0.46	0.76	1.81	4.60

[a] Includes grain snacks such as crackers, salty snacks, popcorn, and pretzels.

NOTE: SE = Standard error
P = Percentile of the distribution

Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-5. Per Capita Intake of Breakfast Foods (g/kg-day as consumed)[a]

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	15.0%	0.144	0.012	0	0	0	0	0	0	0.46	0.95	2.46	13.61
Age (years)													
< 01	13.2%	0.255	0.108	0	0	0	0	0	0	0.57	2.08	3.82	5.72
1-2	20.9%	0.418	0.103	0	0	0	0	0	0.37	1.54	2.50	4.62	9.92
3-5	24.5%	0.446	0.078	0	0	0	0	0	0.56	1.63	2.33	3.92	11.90
6-11	25.0%	0.307	0.045	0	0	0	0	0	0.31	1.12	1.69	2.82	13.61
12-19	18.4%	0.193	0.038	0	0	0	0	0	0	0.65	1.16	3.06	5.38
20-39	13.2%	0.086	0.014	0	0	0	0	0	0	0.31	0.61	1.53	4.41
40-69	10.8%	0.063	0.011	0	0	0	0	0	0	0.23	0.51	0.95	2.98
70 +	12.5%	0.096	0.025	0	0	0	0	0	0	0.41	0.65	1.37	3.09
Season													
Fall	15.1%	0.146	0.021	0	0	0	0	0	0	0.49	0.93	2.61	6.83
Spring	13.2%	0.120	0.023	0	0	0	0	0	0	0.34	0.71	2.32	6.23
Summer	14.8%	0.145	0.022	0	0	0	0	0	0	0.53	0.98	2.02	7.41
Winter	17.0%	0.168	0.027	0	0	0	0	0	0	0.55	1.04	2.94	13.61
Urbanization													
Central City	15.1%	0.142	0.021	0	0	0	0	0	0	0.42	0.93	2.61	7.17
Nonmetropolitan	13.3%	0.120	0.020	0	0	0	0	0	0	0.39	0.85	1.97	7.41
Suburban	15.9%	0.157	0.019	0	0	0	0	0	0	0.52	1.06	2.45	13.61
Race													
Asian	10.1%	0.076	0.060	0	0	0	0	0	0	0.24	0.61	1.04	1.46
Black	11.9%	0.114	0.032	0	0	0	0	0	0	0.20	0.78	2.46	7.41
Native American	18.7%	0.156	0.073	0	0	0	0	0	0.21	0.53	0.61	1.23	6.83
Other/NA	13.7%	0.079	0.037	0	0	0	0	0	0	0.40	0.43	1.40	2.33
White	15.6%	0.152	0.013	0	0	0	0	0	0	0.51	0.97	2.56	13.61
Region													
Midwest	14.7%	0.121	0.020	0	0	0	0	0	0	0.38	0.75	2.06	7.41
Northeast	15.2%	0.158	0.034	0	0	0	0	0	0	0.43	1.02	2.61	13.61
South	12.3%	0.130	0.019	0	0	0	0	0	0	0.42	0.92	2.33	4.59
West	19.7%	0.184	0.024	0	0	0	0	0	0	0.67	1.14	2.58	6.96

[a] Includes breakfast foods made with grains such as pancakes, waffles, and french toast.

NOTE: SE = Standard error
P = Percentile of the distribution

Source: Based on EPA's analysis of the 1989-91

Table 12-6. Per Capita Intake of Pasta (g/kg-day as consumed)

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	13.6%	0.233	0.018	0	0	0	0	0	0	0.90	1.60	3.67	24.01
Age (years)													
< 01	7.3%	0.172	0.124	0	0	0	0	0	0	0.00	1.18	3.79	6.43
1-2	14.0%	0.569	0.212	0	0	0	0	0	0	1.72	5.14	6.68	24.01
3-5	15.3%	0.543	0.142	0	0	0	0	0	0	2.19	3.37	6.51	7.72
6-11	15.9%	0.338	0.063	0	0	0	0	0	0	1.47	2.35	3.43	7.72
12-19	14.3%	0.194	0.047	0	0	0	0	0	0	0.77	1.47	3.36	7.24
20-39	15.2%	0.232	0.027	0	0	0	0	0	0	0.96	1.57	2.83	7.17
40-69	12.5%	0.172	0.028	0	0	0	0	0	0	0.62	1.32	2.67	10.20
70 +	9.9%	0.083	0.029	0	0	0	0	0	0	0.03	0.76	1.57	2.62
Season													
Fall	14.0%	0.239	0.038	0	0	0	0	0	0	0.94	1.72	3.77	24.01
Spring	13.9%	0.250	0.036	0	0	0	0	0	0	0.96	1.65	3.28	9.47
Summer	13.6%	0.251	0.039	0	0	0	0	0	0	0.97	1.72	3.80	11.12
Winter	12.9%	0.193	0.034	0	0	0	0	0	0	0.68	1.33	3.22	8.73
Urbanization													
Central City	12.9%	0.197	0.034	0	0	0	0	0	0	0.65	1.34	3.43	24.01
Nonmetropolitan	11.4%	0.171	0.032	0	0	0	0	0	0	0.63	1.33	2.48	11.12
Suburban	15.4%	0.286	0.028	0	0	0	0	0	0	1.12	1.96	3.92	10.20
Race													
Asian	18.8%	0.918	0.355	0	0	0	0	0	0.70	3.80	5.78	6.51	10.20
Black	6.6%	0.138	0.054	0	0	0	0	0	0	0.00	1.08	3.27	5.14
Other/NA	8.6%	0.115	0.083	0	0	0	0	0	0	0.00	1.16	2.43	3.86
White	15.1%	0.243	0.019	0	0	0	0	0	0	0.94	1.65	3.46	24.01
Region													
Midwest	12.8%	0.182	0.030	0	0	0	0	0	0	0.74	1.24	2.76	9.46
Northeast	21.9%	0.367	0.043	0	0	0	0	0	0	1.47	2.14	4.62	24.01
South	9.2%	0.179	0.035	0	0	0	0	0	0	0.45	1.32	3.63	11.12
West	14.7%	0.252	0.038	0	0	0	0	0	0	1.07	1.63	3.25	10.20

NOTE: SE = Standard error
P = Percentile of the distribution
Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-7. Per Capita Intake of Cooked Cereals (g/kg-day as consumed)

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	17.1%	0.441	0.035	0	0	0	0	0	0	1.37	2.79	8.18	28.63
Age (years)													
< 01	17.9%	1.350	0.417	0	0	0	0	0	0	7.17	8.60	20.47	24.16
1-2	23.6%	1.783	0.365	0	0	0	0	0	1.39	7.00	9.41	14.84	28.63
3-5	21.2%	1.335	0.258	0	0	0	0	0	0	4.99	8.18	12.51	18.66
6-11	18.1%	0.669	0.142	0	0	0	0	0	0	2.32	4.49	10.76	16.42
12-19	11.0%	0.156	0.065	0	0	0	0	0	0	0	1.26	3.34	11.85
20-39	10.5%	0.166	0.040	0	0	0	0	0	0	0	1.33	3.33	13.18
40-69	18.3%	0.307	0.036	0	0	0	0	0	0	1.30	2.20	3.97	18.23
70 +	35.3%	0.782	0.079	0	0	0	0	0	1.08	2.71	3.80	7.37	10.03
Season													
Fall	21.2%	0.573	0.066	0	0	0	0	0	0	1.90	3.71	9.15	28.63
Spring	15.8%	0.439	0.082	0	0	0	0	0	0	1.07	2.29	12.28	21.84
Summer	12.1%	0.288	0.069	0	0	0	0	0	0	0.55	1.98	5.37	24.16
Winter	19.1%	0.463	0.062	0	0	0	0	0	0	1.57	3.12	7.00	24.34
Urbanization													
Central City	19.3%	0.523	0.068	0	0	0	0	0	0	1.52	3.27	10.03	28.63
Nonmetropolitan	20.0%	0.483	0.066	0	0	0	0	0	0	1.52	2.72	7.41	20.94
Suburban	13.9%	0.369	0.052	0	0	0	0	0	0	1.09	2.35	7.37	24.34
Race													
Black	30.3%	0.838	0.092	0	0	0	0	0	0.65	2.95	4.45	10.03	28.63
NativeAmerican	17.5%	0.372	0.196	0	0	0	0	0	0	2.15	2.99	4.80	5.73
Other/NA	12.6%	0.510	0.293	0	0	0	0	0	0	1.12	3.18	7.60	20.94
White	15.1%	0.382	0.039	0	0	0	0	0	0	1.11	2.32	7.38	24.34
Region													
Midwest	15.5%	0.507	0.083	0	0	0	0	0	0	1.39	3.01	10.32	21.85
Northeast	13.2%	0.395	0.093	0	0	0	0	0	0	1.00	2.73	7.02	24.34
South	21.4%	0.396	0.044	0	0	0	0	0	0	1.40	2.48	5.53	28.63
West	15.2%	0.483	0.086	0	0	0	0	0	0	1.45	3.12	9.41	16.47

NOTE: SE = Standard error
P = Percentile of the distribution
Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-8. Per Capita Intake of Rice (g/kg-day as consumed)

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	20.0%	0.357	0.022	0	0	0	0	0	0	1.26	2.15	4.85	17.59
Age (years)													
< 01	11.8%	0.405	0.209	0	0	0	0	0	0	1.40	2.89	7.87	15.54
1-2	24.4%	0.811	0.192	0	0	0	0	0	0.36	3.36	4.52	9.81	17.59
3-5	25.0%	0.736	0.127	0	0	0	0	0	0.76	2.83	3.77	6.70	14.35
6-11	20.8%	0.504	0.090	0	0	0	0	0	0	1.71	3.33	7.86	13.39
12-19	20.1%	0.316	0.052	0	0	0	0	0	0	1.26	1.91	3.74	9.60
20-39	21.3%	0.341	0.037	0	0	0	0	0	0	1.20	1.90	5.02	12.69
40-69	19.6%	0.259	0.028	0	0	0	0	0	0	0.94	1.64	3.35	12.00
70 +	14.9%	0.229	0.050	0	0	0	0	0	0	0.81	1.73	3.12	7.97
Season													
Fall	18.8%	0.307	0.041	0	0	0	0	0	0	0.94	2.13	4.92	16.74
Spring	21.5%	0.395	0.046	0	0	0	0	0	0	1.34	2.47	5.05	15.54
Summer	19.3%	0.376	0.045	0	0	0	0	0	0	1.31	2.05	5.02	12.55
Winter	20.5%	0.350	0.041	0	0	0	0	0	0	1.37	2.09	4.17	17.59
Urbanization													
Central City	26.1%	0.449	0.039	0	0	0	0	0	0.18	1.51	2.51	5.54	16.74
Nonmetropolitan	15.9%	0.311	0.046	0	0	0	0	0	0	1.04	1.90	5.02	12.91
Suburban	18.3%	0.320	0.031	0	0	0	0	0	0	1.16	2.01	4.30	17.59
Race													
Asian	72.5%	2.353	0.316	0	0	0	0	1.32	2.83	6.20	10.39	15.06	17.59
Black	37.2%	0.603	0.048	0	0	0	0	0	0.87	2.08	2.93	5.16	12.91
Other/NA	37.7%	0.655	0.116	0	0	0	0	0	0.80	2.15	3.78	6.06	10.71
White	15.9%	0.281	0.023	0	0	0	0	0	0	0.94	1.79	4.30	15.54
Region													
Midwest	12.3%	0.207	0.046	0	0	0	0	0	0	0.62	1.25	3.59	13.39
Northeast	20.3%	0.378	0.050	0	0	0	0	0	0	1.45	2.15	4.65	16.74
South	25.2%	0.455	0.036	0	0	0	0	0	0	1.62	2.71	5.21	15.54
West	20.4%	0.349	0.045	0	0	0	0	0	0	1.25	1.84	4.52	17.59

NOTE: SE = Standard error
P = Percentile of the distribution
Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-9. Per Capita Intake of Ready-to-Eat Cereals (g/kg-day as consumed[a])

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	45.6%	0.306	0.007	0	0	0	0	0	0.42	0.92	1.37	2.61	7.12
Age (years)													
< 01	38.9%	0.431	0.059	0	0	0	0	0	0.64	1.55	1.94	3.40	4.40
1-2	70.7%	0.954	0.057	0	0	0	0	0.74	1.46	2.28	2.89	4.77	6.47
3-5	77.3%	1.026	0.044	0	0	0	0.31	0.83	1.48	2.35	2.99	3.67	5.65
6-11	69.0%	0.631	0.025	0	0	0	0	0.45	0.92	1.55	1.97	3.12	7.12
12-19	50.8%	0.317	0.019	0	0	0	0	0.16	0.48	0.90	1.14	2.61	4.06
20-39	34.3%	0.174	0.010	0	0	0	0	0	0.23	0.61	0.88	1.51	5.11
40-69	37.1%	0.166	0.008	0	0	0	0	0	0.25	0.55	0.74	1.32	3.36
70 +	52.4%	0.222	0.013	0	0	0	0	0.08	0.36	0.64	0.83	1.55	2.71
Season													
Fall	45.2%	0.293	0.014	0	0	0	0	0	0.40	0.94	1.42	2.38	7.12
Spring	45.6%	0.320	0.015	0	0	0	0	0	0.44	0.95	1.42	2.69	5.88
Summer	46.6%	0.330	0.016	0	0	0	0	0	0.45	0.99	1.42	2.82	5.65
Winter	44.8%	0.280	0.014	0	0	0	0	0	0.39	0.81	1.22	2.61	6.47
Urbanization													
Central City	46.6%	0.319	0.014	0	0	0	0	0	0.43	0.94	1.42	2.86	5.11
Nonmetropolitan	43.6%	0.283	0.014	0	0	0	0	0	0.38	0.85	1.33	2.52	7.12
Suburban	46.0%	0.307	0.011	0	0	0	0	0	0.44	0.93	1.36	2.46	6.47
Race													
Asian	33.6%	0.218	0.065	0	0	0	0	0	0.24	0.81	1.28	2.79	3.12
Black	41.1%	0.269	0.018	0	0	0	0	0	0.40	0.82	1.16	2.50	4.46
Native American	38.6%	0.298	0.078	0	0	0	0	0	0.32	0.76	1.23	3.26	4.40
Other/NA	42.9%	0.340	0.050	0	0	0	0	0	0.43	1.12	1.59	2.69	4.18
White	46.7%	0.311	0.008	0	0	0	0	0	0.42	0.94	1.39	2.61	7.12
Region													
Midwest	48.7%	0.328	0.015	0	0	0	0	0	0.47	0.98	1.37	2.55	7.12
Northeast	46.9%	0.286	0.017	0	0	0	0	0	0.38	0.89	1.33	2.70	6.47
South	41.4%	0.284	0.012	0	0	0	0	0	0.40	0.81	1.26	2.34	5.88
West	47.7%	0.336	0.016	0	0	0	0	0	0.46	1.05	1.47	2.84	5.11

[a] Incluldes dry ready-to-eat corn, rice, wheat, and bran cereals in the form of flakes, puffs, etc.
NOTE: SE = Standard error
P = Percentile of the distribution
Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-10. Per Capita Intake of Baby Cereals (g/kg-day as consumed)

Population Group	Percent Consuming	MEAN	SE	P1	P5	P10	P25	P50	P75	P90	P95	P99	P100
Total	1.1%	0.037	0.051	0	0	0	0	0	0	0	0	0	22.57
Age (years)[a]													
< 01	28.5%	1.205	0.280	0	0	0	0	0	0.64	4.59	6.94	16.99	22.57
Season													
Fall	1.1%	0.036	0.075	0	0	0	0	0	0	0	0	0.69	14.94
Spring	1.1%	0.059	0.138	0	0	0	0	0	0	0	0	0.13	16.99
Summer	1.0%	0.017	0.068	0	0	0	0	0	0	0	0	0	12.03
Winter	1.0%	0.035	0.107	0	0	0	0	0	0	0	0	0	22.57
Urbanization													
Central City	1.3%	0.048	0.088	0	0	0	0	0	0	0	0	1.05	22.57
Nonmetropolitan	0.9%	0.011	0.040	0	0	0	0	0	0	0	0	0	9.41
Suburban	1.0%	0.042	0.093	0	0	0	0	0	0	0	0	0	16.99
Race													
Asian	0.7%	0.017	0.137	0	0	0	0	0	0	0	0	1.10	1.10
Black	2.1%	0.092	0.151	0	0	0	0	0	0	0	0	4.59	22.57
Native American	1.2%	0.010	0.088	0	0	0	0	0	0	0	0	0	1.63
Other/NA	3.1%	0.050	0.133	0	0	0	0	0	0	0	0	2.94	13.42
White	0.8%	0.029	0.059	0	0	0	0	0	0	0	0	0	16.99
Region													
Midwest	1.1%	0.020	0.050	0	0	0	0	0	0	0	0	0	12.50
Northeast	1.0%	0.084	0.208	0	0	0	0	0	0	0	0	1.25	16.99
South	1.0%	0.016	0.060	0	0	0	0	0	0	0	0	0	22.57
West	1.1%	0.046	0.101	0	0	0	0	0	0	0	0	1.18	10.18

[a] Data presented only for children less than 1 year of age. Available data for other age groups was based on a very small number of observations

NOTE: SE = Standard error
P = Percentile of the distribution

Source: Based on EPA's analysis of the 1989-91 CSFII.

Table 12-11. Mean Daily Intakes of Grains Per Individual in a Day for USDA 1977-78, 87-88, 89-91, 94, and 95 Surveys

Food Product	77-78 Data (g/day)	87-88 Data (g/day)	89-91 Data (g/day)	94 Data (g/day)	95 Data (g/day)
Grains	215	237	273	300	303
Grains Mixtures	52	72	89	112	107

Source: USDA, 1980; 1992; 1996a; 1996b.

Table 12-12. Mean Per Capita Intake Rates for Grains Based on All Sex/Age/Demographic Subgroups

Raw Agricultural Commodity[a]	Average Consumption (Grams/kg Body Weight-Day)	Standard Error
Oats	0.0825748	0.0026061
Rice-rough	0.0030600	0.0004343
Rice-milled	0.1552627	0.0083546
Rye-rough	0.0000010	--
Rye-germ	0.0002735	0.0000483
Rye-flour	0.0040285	0.0002922
Wheat-rough	0.1406118	0.0050410
Wheat-germ	0.0008051	0.0000789
Wheat-bran	0.0121575	0.0004864
Wheat-flour	1.2572489	0.0127412
Millet	0.0000216	0.0000104

[a] Consumed in any raw or prepared form.
Source: DRES data base (based on 1977-78 NFCS).

Table 12-13. Mean Grain Intake Per Individual in a Day by Sex and Age (g/day as consumed)[a] for 1977-1978

Group Age (years)	Total Grains	Breads, Rolls, Biscuits	Other Baked Goods	Cereals, Pasta	Mixtures, Mainly Grain[b]
Males and Females					
Under 1	42	4	5	30	3
1-2	158	27	24	44	63
3-5	181	46	37	54	45
6-8	206	53	56	60	38
Males					
9-11	238	67	56	51	64
12-14	288	76	80	57	74
15-18	303	91	77	53	82
19-22	253	84	53	64	52
23-34	256	82	60	40	74
35-50	234	82	58	44	50
51-64	229	78	57	48	46
65-74	235	71	60	69	35
75 and Over	196	70	50	58	19
Females					
9-11	214	58	59	44	53
12-14	235	57	61	45	72
15-18	196	57	43	41	55
19-22	161	44	36	33	48
23-34	163	49	38	32	44
35-50	161	49	37	32	43
51-64	155	52	40	36	27
65-74	175	57	42	47	29
75 and Over	178	54	44	58	22
Males and Females					
All Ages	204	62	49	44	49

[a] Based on USDA Nationwide Food Consumption Survey 1977-78 data for one day.
[b] Includes mixtures containing grain as the main ingredient.
Source: USDA, 1980.

Table 12-14. Mean Grain Intakes Per Individual in a Day by Sex and Age (g/day as consumed)[a] for 1987-1988

Group Age (years)	Total Grains	Yeast Breads and Rolls	Quick Breads, Pancakes, French Toast	Cakes, Cookies, Pastries, Pies	Crackers, Popcorn, Pretzels, Corn Chips	Cereals and Pastas	Mixtures, Mostly Grain[b]
Males and Females 5 and Under	167	30	8	22	4	52	51
Males						74	83
6-11	268	51	16	37	8	72	82
12-19	304	65	28	45	10	58	83
20 and Over	272	65	20	37	8		
Females							
6-11	231	43	19	30	6	66	68
12-19	239	45	13	29	7	52	91
20 and Over	208	45	14	28	6	53	62
All Individuals	237	52	16	32	7	57	72

[a] Based on USDA Nationwide Food Consumption Survey 1987-88 data for one day.
[b] Includes mixtures containing grain as the main ingredient.
Source: USDA, 1992.

Table 12-15. Mean Grain Intakes Per Individual in a Day by Sex and Age (g/day as consumed)[a] for 1994 and 1995

Group Age (years)	Total Grains		Yeast Breads and Rolls		Quick Breads, Pancakes, French Toast		Cakes, Cookies, Pastries, Pies		Crackers, Popcorn, Pretzels, Corn Chips		Cereals and Pastas		Mixtures, Mostly Grain[b]	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Males and Females 5 and Under	213	210	26	28	11	11	22	23	8	7	58	57	89	84
Males														
6-11	285	341	51	45	15	21	42	46	12	18	66	97	101	115
12-19	417	364	53	54	30	21	54	43	17	22	82	84	180	138
20 and Over	357	365	64	61	22	24	43	46	13	15	86	91	128	128
Females														
6-11	260	286	43	46	16	21	37	51	11	14	57	54	94	100
12-19	317	296	40	37	16	14	39	35	17	16	63	52	142	143
20 and Over	254	257	44	45	16	15	33	34	9	10	59	69	92	83
All Individuals	300	303	50	49	18	19	38	39	12	13	70	76	112	107

[a] Based on USDA CSFII 1994 and 1995 data for one day.
[b] Includes mixtures containing grain as the main ingredient.
Source: USDA, 1996a; 1996b.

Table 12-16. Mean and Standard Error for the Daily Per Capita Intake of Grains, by Age (g/day as consumed)

Age (years)	Breads	Cereals	Other Grains
All ages	147.3±1.4	29.9±1.3	22.9±1.7
Under 1	16.2±9.2	37.9±8.2	1.8±10.9
1 to 4	104.6±4.5	38.4±4.0	14.8±5.4
5 to 9	154.3±3.8	39.5±3.4	22.7±4.5
10 to 14	186.2±3.6	36.4±3.2	25.6±4.2
15 to 19	188.5±3.7	28.8±3.3	27.8±4.4
20 to 24	166.5±4.9	20.2±4.3	25.0±5.8
25 to 29	170.0±5.0	18.2±4.4	26.6±5.9
30 to 39	156.8±3.9	18.8±3.5	26.4±4.6
40 to 59	144.4±3.1	24.7±2.7	23.3±3.6
60 and over	122.1±3.4	42.5±3.0	19.3±4.0

Source: U.S. EPA, 1984a (based on 1977-78 NFCS).

Table 12-17. Mean and Standard Error for the Daily Intake of Grains, by Region (g/day as consumed)

Region	Total Grains	Breads	Cereals	Other Grains
All Regions	200.0±3.0	147.3±1.4	29.9±1.3	22.9±1.7
Northeast	203.5±5.8	153.1±2.8	24.6±2.5	25.9±3.3
North Central	192.8±5.6	150.9±2.7	28.7±2.4	13.3±3.2
South	202.2±4.7	143.9±2.3	34.6±2.0	23.7±2.7
West	202.6±6.9	139.5±3.3	30.9±3.0	32.1±4.0

NOTE: Northeast = Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, and Pennsylvania.

North Central = Ohio, Illinois, Indiana, Wisconsin, Michigan, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

South = Maryland, Delaware, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Texas, and Oklahoma.

West = Montana, Idaho, Wyoming, Utah, Colorado, New Mexico, Arizona, Nevada, Washington, Oregon, and California.

Source: U.S. EPA, 1984b (based on 1977-78 NFCS).

Table 12-18. Consumption of Grains (g dry weight/day) for Different Age Groups and Estimated Lifetime Average Daily Food Intakes for a U.S. Citizen (averaged across sex) Calculated from the FDA Diet Data

	Age (years)						Estimated lifetime[a]
	(0-1)	(1-5)	(6-13)	(14-19)	(20-44)	(45-70)	
Wheat	27.60	42.23	60.80	79.36	65.86	55.13	60.30
Corn	4.00	15.35	19.28	23.21	12.83	14.82	12.01
Rice	2.22	4.58	5.24	5.89	5.78	4.21	5.03
Oats	3.73	2.65	2.27	1.89	1.32	2.00	1.85
Other Grain	0.01	0.08	0.41	0.73	13.45	4.41	6.49
Total Grain	37.56	64.82	87.58	110.34	90.59	76.12	84.19

[a] The estimated lifetime dietary intakes were estimated by:

$$\text{Estimated lifetime} = \frac{IR(0\text{-}1) + 5\text{yrs} * IR(1\text{-}5) + 8\text{ yrs} * IR(6\text{-}13) + 6\text{ yrs} * IR(14\text{-}19) + 25\text{ yrs} * IR(20\text{-}44) + 25\text{ yrs} * IR(45\text{-}70)}{70\text{ years}}$$

where IR = the intake rate for a specific age group.

Source: U.S. EPA, 1989 (based on 1977-78 NFCS and NHANES II data).

Table 12-19. Per Capita Consumption of Flour and Cereal Products in 1991[a]

Food Item	Per Capita Consumption (g/day)[a]
Total Wheat Flour[b]	169.8
Rye Flour	0.7
Rice[c]	20.9
Total Corn Products[d]	27.2
Oat Products[e]	10.7
Barley Products[f]	1.1
Total Flour and Cereal Products[g]	230.6

[a] Original data were presented in lbs/yr; data were converted to g/day by multiplying by a factor of 454 g/lb and dividing by 365 days/yr. Consumption of most items at the processing level. Excludes quantities used in alcoholic beverages and fuel.
[b] Includes white, whole wheat, and durum flour.
[c] Milled basis.
[d] Includes corn flour and meal, hominy and grits, and corn starch.
[e] Includes rolled oats, ready-to-eat cereals, oat flour, and oat bran.
[f] Includes barley flour, pearl barley, and malt and malt extract used in food processing.
[g] Excludes wheat not ground into flour, for example, shredded wheat breakfast cereals.
Source: USDA, 1993.

Table 12-20. Quantity (as consumed) of Grain Products Consumed Per Eating Occasion and the Percentage of Individuals Using These Foods in Three Days

Food category	% Indiv. using food in 3 days	Quantity consumed per eating occasion (g)		Consumers-only Quantity consumed per eating occasion at specified percentiles (g)						
		Average	Standard Deviation	5	25	50	75	90	95	99
Yeast Breads	93.7	46	26	21	25	44	50	75	100	140
Pancakes	8.3	113	85	27	54	81	146	219	282	438
Waffles	2.9	87	74	20	40	78	100	158	200	400
Tortillas	2.9	69	39	28	30	60	90	120	140	210
Cakes and Cupcakes	25.5	79	59	23	41	63	99	144	184	284
Cookies	30.8	32	30	7	14	26	40	60	84	144
Pies	11.9	129	60	57	97	120	150	195	236	360
Doughnuts	9.9	64	40	26	42	43	84	106	126	208
Crackers	26.2	22	21	6	12	15	24	42	57	113
Popcorn	5.6	19	22	5	9	15	18	36	45	108
Pretzels	2.2	29	28	3	12	21	36	57	85	160
Corn-based Salty Snacks	5.9	33	30	9	18	21	40	60	80	156
Pasta	11.4	153	108	35	70	140	210	280	320	560
Rice	18.5	147	91	41	88	165	125	263	350	438
Cooked Cereals	12.4	203	110	31	123	240	245	360	480	490
Ready-to-Eat Cereals	43.4	36	25	8	22	29	45	60	84	120

Source: Pao et al., 1982 (based on 1977-78 NFCS).

Table 12-21. Mean Moisture Content of Selected Grains Expressed as Percentages of Edible Portions

Food	Moisture Content (Percent)		Comments
	Raw	Cooked	
Barley - pearled	10.09	68.80	
Corn - grain - endosperm	10.37		
Corn - grain - bran	3.71		crude
Millet	8.67	71.41	
Oats	8.22		
Rice - rough - white	11.62	68.72	
Rye - rough	10.95		
Rye - flour - medium	9.85		
Sorghum (including milo)	9.20		
Wheat - rough - hard white	9.57		
Wheat - germ	11.12		crude
Wheat - bran	9.89		crude
Wheat - flour - whole grain	10.27		

Source: USDA, 1979-1986.

Table 12-22. Summary of Grain Intake Studies

Study	Survey Population Used in Calculating Intake	Types of Data Used	Units	Food Items
KEY STUDIES				
EPA Analysis of 1989-91 CSFII Data	Per capita	1989-91 CSFII data; Based on 3-day average individual intake rates.	g/kg-day; as consumed	Distributions of intake rates for total grain; individual grain items
RELEVANT STUDIES				
EPA's DRES (White et al., 1983)	Per capita (i.e., consumers and nonconsumers)	1977-78 NFCS 3-day individual intake data	g/kg-day; as consumed	Intake for a wide variety of grain products presented; complex food groups were disaggregated
Pao et al., 1982	Consumers only serving size data provided	1977-78 NFCS 3-day individual intake data	g; as consumed	Distributions of serving sizes for grain products
USDA, 1980; 1992; 1996a; 1996b	Per capita and consumer only grouped by age and sex	1977-78 and 1987-88 NFCS, and 1994 and 1995 CSFII 1-day individual intake data	g/day; as consumed	Total grains and various grain products
USDA, 1993b	Per capita consumption based on "food disappearance"	Based on food supply and utilization data	g/day; as consumed	Intake rates of grain products
U.S. EPA/ORP, 1984a; 1984b	Per capita	1977-78 NFCS Individual intake data	g/day; as consumed	Mean intake rates for total grain products, and individual grain items.
U.S. EPA/OST, 1989	Estimated lifetime dietary intake	Based on FDA Total Diet Study Food List which used 1977-78 NFCS data, and NHANES II data	g/day; dry weight	Various food groups; complex foods disaggregated

Table 12-23. Summary of Recommended Values for Per Capita Intake of Grain Products

Mean	95th Percentile	Multiple Percentiles	Study
Total Grain Intake			
4.1 g/kg-day	10.8 g/kg-day	see Table 12-1	EPA Analysis of CSFII 1989-91 Data
Individual Grain Products			
see Tables 12-2 to 12-10	see Tables 12-2 to 12-10	see Table 12-2 to 12-10	EPA Analysis of CSFII 1989-91 Data

Table 12-24. Confidence in Grain Products Intake Recommendation

Considerations	Rationale	Rating
Study Elements		
• Level of peer review	USDA CSFII survey receives high level of peer review. EPA analysis of these data has been peer reviewed outside the Agency.	High
• Accessibility	CSFII data are publicly available.	High
• Reproducibility	Enough information is included to reproduce results.	High
• Focus on factor of interest	Analysis is specifically designed to address food intake.	High
• Data pertinent to U.S.	Data focuses on the U.S. population.	High
• Primary data	This is new analysis of primary data.	High
• Currency	Were the most current data publicly available at the time the analysis was conducted for this Handbook.	High
• Adequacy of data collection period	Survey is designed to collect short-term data.	Medium confidence for average values; Low confidence for long term percentile distribution
• Validity of approach	Survey methodology was adequate.	High
• Study size	Study size was very large and therefore adequate.	High
• Representativeness of the population	The population studied was the U.S. population.	High
• Characterization of variability	Survey was not designed to capture long term day-to-day variability. Short term distributions are provided for various age groups, regions, etc.	Medium
• Lack of bias in study design (high rating is desirable)	Response rate was adequate.	Medium
• Measurement error	No measurements were taken. The study relied on survey data.	N/A
Other Elements		
• Number of studies	1 CSFII was the most recent data set publicly available at the time the analysis was conducted for this Handbook. Therefore, it was the only study classified as key study.	Low
• Agreement between researchers	Although the CSFII was the only study classified as key study, the results are in good agreement with earlier data.	High
Overall Rating	The survey is representative of U.S. population. Although there was only one study considered key, these data are the most recent and are in agreement with earlier data. The approach used to analyze the data was adequate. However, due to the limitations of the survey design estimation of long-term percentile values (especially the upper percentiles) is uncertain.	High confidence in the average; Low confidence in the long-term upper percentiles

APPENDIX 12A

FOOD CODES AND DEFINITIONS USED IN THE ANALYSIS OF THE 1989-91 USDA CSFII GRAINS DATA

Table 12A-1. Food Codes and Definitions Used in the Analysis of the 1989-91 USDA CSFII Grains Data

Food Product	Food Codes and Descriptions		Food Product	Food Codes and Descriptions	
Total Grains	51- 52- 53- 54- 55- 561- 562- 57- Also includes the average portion of grain mixtures (i.e., 31 percent) and the average portion of meat mixtures (i.e., 13 percent) made up by grain.	breads tortillas sweets snacks breakfast foods pasta cooked cereals and rice ready-to-eat and baby cereals	Pasta	561-	macaroni noodles spaghetti
Breads	51- 52-	breads rolls muffins bagel biscuits corn bread tortillas	Cooked Cereals	56200- 56201- 56202- 56203- 562069- 56207- 56208- 56209-	includes grits,oatmeal, cornmeal mush, millet, etc.
Sweets	53-	cakes cookies pies pastries doughnuts breakfast bars coffee cakes	Rice	56204- 56205- 5620601	includes all varieties of rice
Snacks	54-	crackers salty snacks popcorn pretzels	Ready-to-eat Cereals	570- 571- 572- 573- 574- 575- 576-	includes all varieties of ready-to-eat cereals
Breakfast Foods	55-	pancakes waffles french toast	Baby Cereals	578-	baby cereals
Grain Mixtures	58-	grain mixtures	Meat Mixtures	27- 28-	meat mixtures